

52. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium



PROCEEDINGS

| 10 - 13 September 2007

FACULTY OF COMPUTER SCIENCE AND AUTOMATION



COMPUTER SCIENCE MEETS AUTOMATION

VOLUME II

Session 6 - Environmental Systems: Management and Optimisation

**Session 7 - New Methods and Technologies for Medicine and
Biology**

Session 8 - Embedded System Design and Application

Session 9 - Image Processing, Image Analysis and Computer Vision

Session 10 - Mobile Communications


Session 11 - Education in Computer Science and Automation

Bibliografische Information der Deutschen Bibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über <http://dnb.ddb.de> abrufbar.

ISBN 978-3-939473-17-6

Impressum

- Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
- Redaktion: Referat Marketing und Studentische Angelegenheiten
Kongressorganisation
Andrea Schneider
Tel.: +49 3677 69-2520
Fax: +49 3677 69-1743
e-mail: kongressorganisation@tu-ilmenau.de
- Redaktionsschluss: Juli 2007
- Verlag: 
Technische Universität Ilmenau/Universitätsbibliothek
Universitätsverlag Ilmenau
Postfach 10 05 65
98684 Ilmenau
www.tu-ilmenau.de/universitaetsverlag
- Herstellung und Auslieferung: Verlagshaus Monsenstein und Vannerdat OHG
Am Hawerkamp 31
48155 Münster
www.mv-verlag.de
- Layout Cover: www.cey-x.de
- Bezugsmöglichkeiten: Universitätsbibliothek der TU Ilmenau
Tel.: +49 3677 69-4615
Fax: +49 3677 69-4602

© Technische Universität Ilmenau (Thür.) 2007

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine Verwertung ohne Einwilligung der Redaktion strafbar.

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.

I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.



Professor Peter Scharff
Rector, TU Ilmenau



Professor Christoph Ament
Head of Organisation

CONTENTS

	Page
6 Environmental Systems: Management and Optimisation	
T. Bernard, H. Linke, O. Krol A Concept for the long term Optimization of regional Water Supply Systems as a Module of a Decision Support System	3
S. Röhl, S. Hopfgarten, P. Li A groundwater model for the area Darkhan in Kharaa river Th. Bernard, H. Linke, O. Krol basin	11
A. Khatanbaatar Altantuul The need designing integrated urban water management in cities of Mongolia	17
T. Rauschenbach, T. Pfützenreuter, Z. Tong Model based water allocation decision support system for Beijing	23
T. Pfützenreuter, T. Rauschenbach Surface Water Modelling with the Simulation Library ILM-River	29
D. Karimanzira, M. Jacobi Modelling yearly residential water demand using neural networks	35
Th. Westerhoff, B. Scharaw Model based management of the drinking water supply system of city Darkhan in Mongolia	41
N. Buyankhishig, N. Batsukh Pumping well optimi ation in the Shivee-Ovoo coal mine Mongolia	47
S. Holzmüller-Laue, B. Göde, K. Rimane, N. Stoll Data Management for Automated Life Science Applications	51
N. B. Chang, A. Gonzalez A Decision Support System for Sensor Deployment in Water Distribution Systems for Improving the Infrastructure Safety	57
P. Hamolka, I. Vrublevsky, V. Parkoun, V. Sokol New Film Temperature And Moisture Microsensors for Environmental Control Systems	63
N. Buyankhishig, M. Masumoto, M. Aley Parameter estimation of an unconfined aquifer of the Tuul River basin Mongolia	67

M. Jacobi, D. Karimanzira	73
Demand Forecasting of Water Usage based on Kalman Filtering	

7 New Methods and Technologies for Medicine and Biology

J. Meier, R. Bock, L. G. Nyúl, G. Michelson	81
Eye Fundus Image Processing System for Automated Glaucoma Classification	
L. Hellrung, M. Trost	85
Automatic focus depending on an image processing algorithm for a non mydriatic fundus camera	
M. Hamsch, C. H. Igney, M. Vauhkonen	91
A Magnetic Induction Tomography System for Stroke Classification and Diagnosis	
T. Neumuth, A. Pretschner, O. Burgert	97
Surgical Workflow Monitoring with Generic Data Interfaces	
M. Pfaff, D. Woetzel, D. Driesch, S. Toepfer, R. Huber, D. Pohlers, D. Koczan, H.-J. Thiesen, R. Guthke, R. W. Kinne	103
Gene Expression Based Classification of Rheumatoid Arthritis and Osteoarthritis Patients using Fuzzy Cluster and Rule Based Method	
S. Toepfer, S. Zellmer, D. Driesch, D. Woetzel, R. Guthke, R. Gebhardt, M. Pfaff	107
A 2-Compartment Model of Glutamine and Ammonia Metabolism in Liver Tissue	
J. C. Ferreira, A. A. Fernandes, A. D. Santos	113
Modelling and Rapid Prototyping an Innovative Ankle-Foot Orthosis to Correct Children Gait Pathology	
H. T. Shandiz, E. Zahedi	119
Noninvasive Method in Diabetic Detection by Analyzing PPG Signals	
S. V. Drobot, I. S. Asayenok, E. N. Zacepin, T. F. Sergiyenko, A. I. Svirnovskiy	123
Effects of Mm-Wave Electromagnetic Radiation on Sensitivity of Human Lymphocytes to Ionizing Radiation and Chemical Agents in Vitro	

8 Embedded System Design and Application

B. Däne	131
Modeling and Realization of DMA Based Serial Communication for a Multi Processor System	

M. Müller, A. Pacholik, W. Fengler Tool Support for Formal System Verification	137
A. Pretschner, J. Alder, Ch. Meissner A Contribution to the Design of Embedded Control Systems	143
R. Ubar, G. Jervan, J. Raik, M. Jenihhin, P. Ellervee Dependability Evaluation in Fault Tolerant Systems with High-Level Decision Diagrams	147
A. Jutmann On LFSR Polynomial Calculation for Test Time Reduction	153
M. Rosenberger, M. J. Schaub, S. C. N. Töpfer, G. Linß Investigation of Efficient Strain Measurement at Smallest Areas Applying the Time to Digital (TDC) Principle	159
 9 Image Processing, Image Analysis and Computer Vision	
J. Meyer, R. Espiritu, J. Earthman Virtual Bone Density Measurement for Dental Implants	167
F. Erfurth, W.-D. Schmidt, B. Nyuyki, A. Scheibe, P. Saluz, D. Faßler Spectral Imaging Technology for Microarray Scanners	173
T. Langner, D. Kollhoff Farbbasierte Druckbildinspektion an Rundkörpern	179
C. Lucht, F. Gaßmann, R. Jahn Inline-Fehlerdetektion auf freigeformten, texturierten Oberflächen im Produktionsprozess	185
H.-W. Lahmann, M. Stöckmann Optical Inspection of Cutting Tools by means of 2D- and 3D-Imaging Processing	191
A. Melitzki, G. Stanke, F. Weckend Bestimmung von Raumpositionen durch Kombination von 2D-Bildverarbeitung und Mehrfachlinienlasertriangulation - am Beispiel von PKW-Stabilisatoren	197
F. Boochs, Ch. Raab, R. Schütze, J. Traiser, H. Wirth 3D contour detection by means of a multi camera system	203

M. Brandner Vision-Based Surface Inspection of Aeronautic Parts using Active Stereo	209
H. Lettenbauer, D. Weiss X-ray image acquisition, processing and evaluation for CT-based dimensional metrology	215
K. Sickel, V. Daum, J. Hornegger Shortest Path Search with Constraints on Surface Models of In-the-ear Hearing Aids	221
S. Husung, G. Höhne, C. Weber Efficient Use of Stereoscopic Projection for the Interactive Visualisation of Technical Products and Processes	227
N. Schuster Measurement with subpixel-accuracy: Requirements and reality	233
P. Brückner, S. C. N. Töpfer, M. Correns, J. Schnee Position- and colour-accurate probing of edges in colour images with subpixel resolution	239
E. Sparrer, T. Machleidt, R. Nestler, K.-H. Franke, M. Niebelschütz Deconvolution of atomic force microscopy data in a special measurement mode – methods and practice	245
T. Machleidt, D. Kapusi, T. Langner, K.-H. Franke Application of nonlinear equalization for characterizing AFM tip shape	251
D. Kapusi, T. Machleidt, R. Jahn, K.-H. Franke Measuring large areas by white light interferometry at the nanopositioning and nanomeasuring machine (NPM)M)	257
R. Burdick, T. Lorenz, K. Bobey Characteristics of High Power LEDs and one example application in with-light-interferometry	263
T. Koch, K.-H. Franke Aspekte der strukturbasierten Fusion multimodaler Satellitendaten und der Segmentierung fusionierter Bilder	269
T. Riedel, C. Thiel, C. Schmallius A reliable and transferable classification approach towards operational land cover mapping combining optical and SAR data	275
B. Waske, V. Heinzl, M. Braun, G. Menz Classification of SAR and Multispectral Imagery using Support Vector Machines	281

V. Heinzl, J. Franke, G. Menz Assessment of differences in multisensoral remote sensing imageries caused by discrepancies in the relative spectral response functions	287
I. Aksit, K. Bünger, A. Fassbender, D. Frekers, Chr. Götze, J. Kemenas An ultra-fast on-line microscopic optical quality assurance concept for small structures in an environment of man production	293
D. Hofmann, G. Linss Application of Innovative Image Sensors for Quality Control	297
A. Jablonski, K. Kohrt, M. Böhm Automatic quality grading of raw leather hides	303
M. Rosenberger, M. Schellhorn, P. Brückner, G. Linß Uncompressed digital image data transfer for measurement techniques using a two wire signal line	309
R. Blaschek, B. Meffert Feature point matching for stereo image processing using nonlinear filters	315
A. Mitsiukhin, V. Pachynin, E. Petrovskaya Hartley Discrete Transform Image Coding	321
S. Hellbach, B. Lau, J. P. Eggert, E. Körner, H.-M. Groß Multi-Cue Motion Segmentation	327
R. R. Alavi, K. Brieß Image Processing Algorithms for Using a Moon Camera as Secondary Sensor for a Satellite Attitude Control System	333
S. Bauer, T. Döring, F. Meysel, R. Reulke Traffic Surveillance using Video Image Detection Systems	341
M. A-Megeed Salem, B. Meffert Wavelet-based Image Segmentation for Traffic Monitoring Systems	347
E. Einhorn, C. Schröter, H.-J. Böhme, H.-M. Groß A Hybrid Kalman Filter Based Algorithm for Real-time Visual Obstacle Detection	353
U. Knauer, R. Stein, B. Meffert Detection of opened honeybee brood cells at an early stage	359

10 Mobile Communications

K. Ghanem, N. Zamin-Khan, M. A. A. Kalil, A. Mitschele-Thiel Dynamic Reconfiguration for Distributing the Traffic Load in the Mobile Networks	367
N. Z.-Khan, M. A. A. Kalil, K. Ghanem, A. Mitschele-Thiel Generic Autonomic Architecture for Self-Management in Future Heterogeneous Networks	373
N. Z.-Khan, K. Ghanem, St. Leistritz, F. Liers, M. A. A. Kalil, H. Kärst, R. Böringer Network Management of Future Access Networks	379
St. Schmidt, H. Kärst, A. Mitschele-Thiel Towards cost-effective Area-wide Wi-Fi Provisioning	385
A. Yousef, M. A. A. Kalil A New Algorithm for an Efficient Stateful Address Autoconfiguration Protocol in Ad hoc Networks	391
M. A. A. Kalil, N. Zamin-Khan, H. Al-Mahdi, A. Mitschele-Thiel Evaluation and Improvement of Queueing Management Schemes in Multihop Ad hoc Networks	397
M. Ritzmann Scientific visualisation on mobile devices with limited resources	403
R. Brecht, A. Kraus, H. Krömker Entwicklung von Produktionsrichtlinien von Sport-Live-Berichterstattung für Mobile TV Übertragungen	409
N. A. Tam RCS-M: A Rate Control Scheme to Transport Multimedia Traffic over Satellite Links	421
Ch. Kellner, A. Mitschele-Thiel, A. Diab Performance Evaluation of MIFA, HMIP and HAWAII	427
A. Diab, A. Mitschele-Thiel MIFAv6: A Fast and Smooth Mobility Protocol for IPv6	433
A. Diab, A. Mitschele-Thiel CAMP: A New Tool to Analyse Mobility Management Protocols	439

11 Education in Computer Science and Automation

S. Bräunig, H.-U. Seidel Learning Signal and Pattern Recognition with Virtual Instruments	447
St. Lambeck Use of Rapid-Control-Prototyping Methods for the control of a nonlinear MIMO-System	453
R. Pittschellis Automatisierungstechnische Ausbildung an Gymnasien	459
A. Diab, H.-D. Wuttke, K. Henke, A. Mitschele-Thiel, M. Ruhwedel MAeLE: A Metadata-Driven Adaptive e-Learning Environment	465
V. Zöppig, O. Radler, M. Beier, T. Ströhla Modular smart systems for motion control teaching	471
N. Pranke, K. Froitzheim The Media Internet Streaming Toolbox	477
A. Fleischer, R. Andreev, Y. Pavlov, V. Terzieva An Approach to Personalized Learning: A Technique of Estimation of Learners Preferences	485
N. Tsyrelchuk, E. Ruchaevskaia Innovational pedagogical technologies and the Information educational medium in the training of the specialists	491
Ch. Noack, S. Schwintek, Ch. Ament Design of a modular mechanical demonstration system for control engineering lectures	497

H.-Wolfg. Lahmann / M. Stöckmann

Optical Inspection of Cutting Tools by means of 2D- and 3D-Image Processing

Image Processing, Image Analysis and Computer Visions

ABSTRACT

2D-and 3D-image processing systems become more and more important in the cutting tool industry. Because of increased requirements to the different machining processes (e.g. milling, turning, grinding) the used cutting tools must have a very high quality. Hence, it is necessary to evaluate the tools quality before they are used in the machine. The non-contact determination of quality parameters by means of image processing systems is therefore of special relevance. This paper presents a solution of 2D-inspection of cutting inserts for hard-whirling processes and a 3D-measuring approach in order to evaluate features of the surface topography of grinding tools.

1 INTRODUCTION

The hard-whirling process is the most economical milling procedure for the production of threads and thread-like profiles. Hard whirling uses profiled cutting inserts which must be specially prepared.

The profiling of new and worn cutting inserts for whirling tools is realised by a grinding process. Before the grinding process can start the correct processing parameters for the machine are to be determined. For the determination of processing parameters the geometry (i.e. the contour) and the wear of already used cutting inserts are to be measured by means of a vision system. In the first part of this paper a developed solution will be presented to evaluate the profile and face wear of cutting inserts. In the second part two investigated measuring principles for the evaluation of surface topography features of grinding tools, which are used in profiling process of cutting inserts et al., will be described.

2 DETERMINATION OF WEAR FEATURES OF CUTTING INSERTS

In order to detect and to evaluate the wear appearances it is necessary to use incident lights for acquisition of face wear and transmitted light for acquisition of profile wear.

Fig. 1 shows both applied measuring principles.

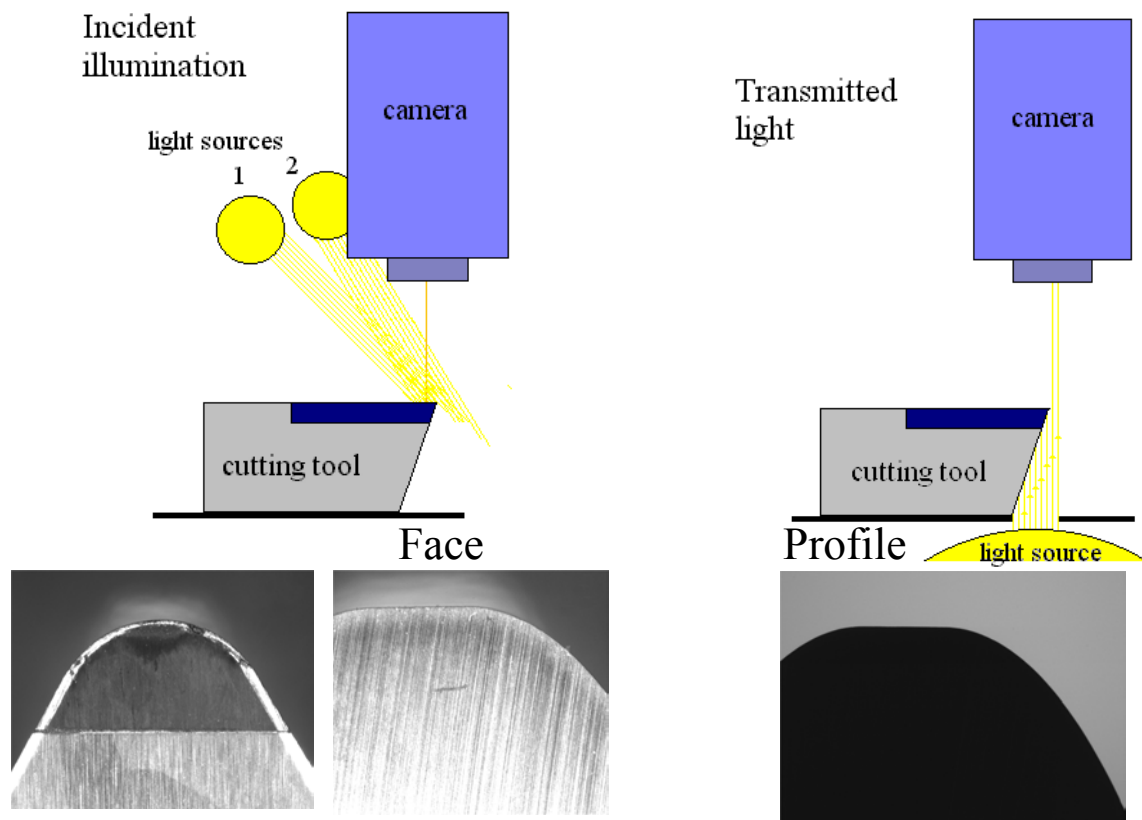


Fig.1: 2D-Measuring principles

For the detection of both kinds of wear appearances a coordinate measuring device with a high resolution CCD matrix camera and a special illumination unit are used. The measuring device is coupled to a computer system to control the grinding machine which profiles the tools to be used in the hard-whirling process. The incident illumination unit consists of two light sources which are aligned onto the focus of the camera system (Fig. 2). The light sources are automatically controlled by evaluating the contrast of the surfaces measured. Angles of the cutting surface can be measured to an accuracy of 2 degrees. This illumination allows image acquisition with reproducible quality and full contrast pictures. The separate radial and vertical positioning of the illuminator arms enables to light up any cutting face profiles for an evaluation.

On the basis of the dimension of cutting inserts some images of the cutting face are

captured and fit together. This is based on the necessary magnification of the cutting face for the take up of the wear dimension. For this reproduction you need a 3 times magnification on the coordinate measuring device (UNI-VIS 250, Mahr OKM GmbH) with an appropriate image size of 2.44mm x 2.46mm. In relation to this image field you need 3 up to 12 pictures depending on the whirling blade (cutting insert) size. These images have to be taken up overlapped, with the same contrast /1/.

The determination of profile wear is carried out in transmitted light by means of 2D-image processing approach. At this principle the cutting edge of whirling insert is projected as bright/dark transition on the camera. The bright/dark transition is detected via measuring line, located perpendicular to the cutting edge, and as scatter-plot of measuring data is recorded. About the measured x-y-positions of coordinate table of measuring device in relation to the CCD-camera the data will be exactly related to each other and evaluated. The measuring process occurs fully automated on the basis of CAD files. The end result is the profile deviation between actual- und nominal contour /2/.

The face wear is captured in incident light (Fig. 2). After image acquisition of all single-regions of the insert surface the captured images are fit together in order to evaluate the surface wear (Fig. 3). Afterwards follows the calculation of wear in several steps. Based on the cutting edge the position of the chamfer is determined at first, if presented, and then it will be determined the areas of wear. The face wear is subdivided in breakouts as well as in width and depth of wear. The determination of depth of wear is carried out separately by means of a 3D-image processing approach (according to confocal principle) /3/.

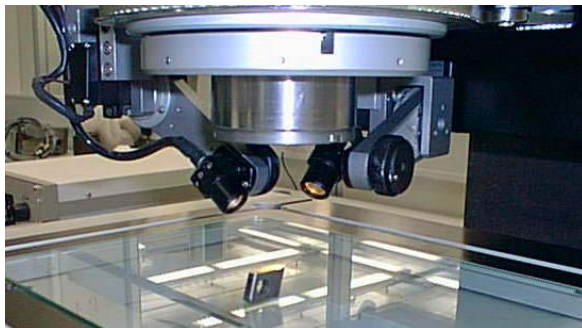


Fig. 2: Incident light source

(Source: Mahr OKM)

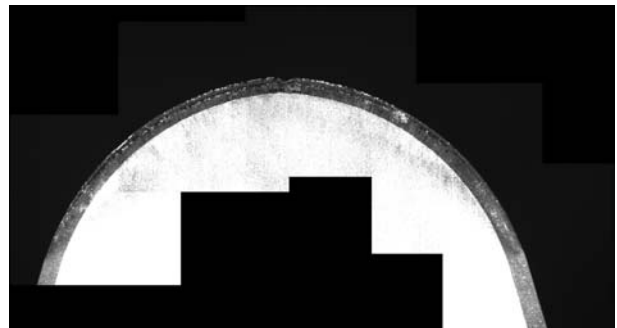


Fig. 3: Composed images

3 DETERMINATION OF SURFACE FEATURES OF GRINDING TOOLS

High precision and economical grinding of cutting tools as well as of workpieces can only be done by means of very sharp grinding tools. Therefore the topography of grinding tools plays a very high importance. Electroplated grinding tools (metal bonded grinding tools) have generally a single grinding layer. This thickness depends on the process of electroplating the grinding grains in the bonding matrix and reaches values between 30% up to 60% of the used grain size. The production process of electroplated grinding tools is determined by statistical procedures, which also influence the physical characteristics.

The key features for the topography of electroplated grinding tools are the average grain protrusion (Fig. 4) and the average deviation of the grain peaks. Based on a White-Light-Interferometer and a Confocal System with Super-Long-Working-Distance- Objectives 3D-image processing approach were investigated in order to determine the key features for the topography of grinding tools.

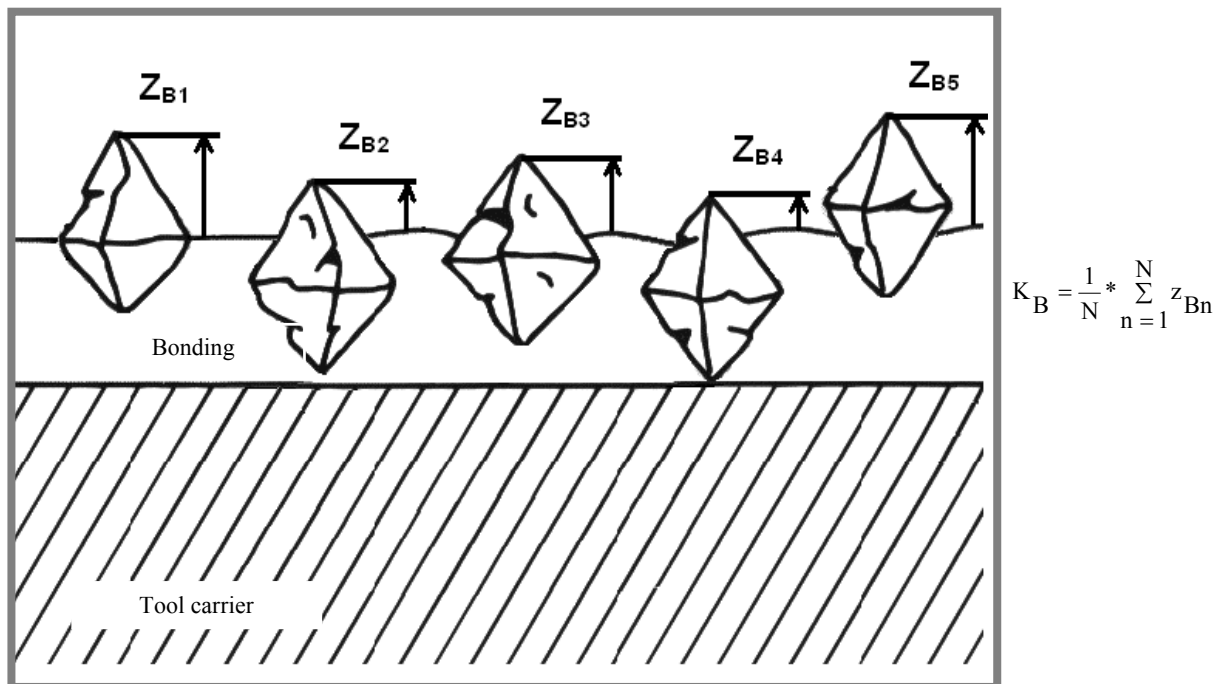


Fig. 4: Average grain protrusion (K_B)

At the White Light Interferometry the short coherence length of white light source is used. A beam of white light is split. One beam is projected on the tool surface to be measured, the other is projected on reference mirror. After reflection at the surface, both beams recombine and interfere (correlogram, Fig. 5). A CCD-camera captures the local intensity created as function of the tool topography. Moving the grinding tool during the

measurement changes the interference pattern, which allows the determination of maximal values of grain peaks and the bonding level. Based on this information a computer generates a 3D-image of the tool's topography. Following the 3D-image is used in order to calculate the average grain protrusion and the average deviation of the grain peaks.

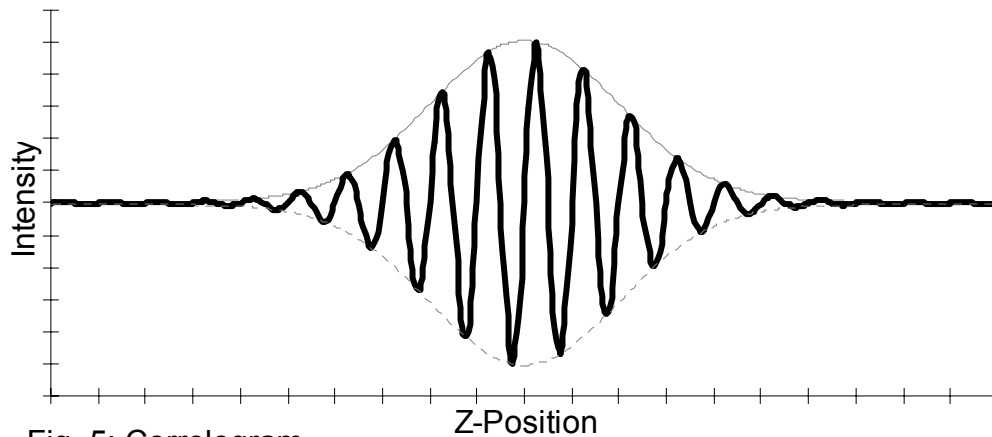


Fig. 5: Correlogram

At the Confocal System (Fig. 7) microscope objectives with high numerical apertures ($0.6 < N < 1.4$) and super-long-working-distance are used. The optical unit (camera, illumination) of the Confocal System is advanced vertically in steps so that each point on the tool surface passes through the focus. The focus function (contrast in depending of vertical position) is determined for each pixel of the CCD-camera. Then the maximum of each focus function is determined and out of it the 3D-image is generated (Fig. 6). The 3D-image data is the basis for the calculation of the average grain protrusion and the average deviation of the grain peaks [4].

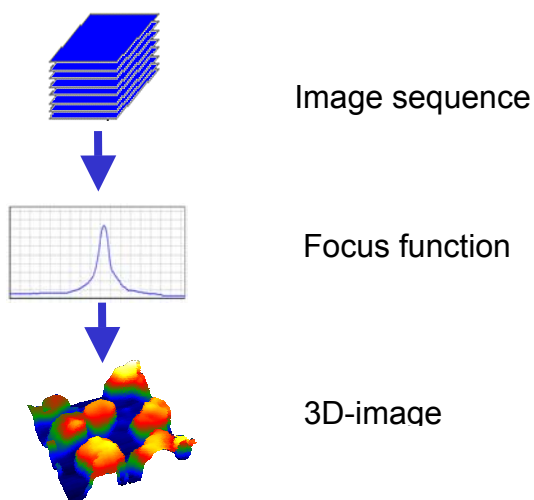


Fig. 6: Procedure



Fig. 7: Confocal System

Both the White Light Interferometry and the Confocal Microscopy may be used for the determination of the average grain protrusion and the average deviation of the grain peaks of electroplated grinding tools. The achieved results have shown that the topography of grinding tools with natural grains is better to detect by means of the Confocal Microscopy than by means of the White Light Interferometry. Investigations on grinding tools with synthetic grains showed good results based on the White Light Interferometry.

In consideration of required measuring time and accuracy of measurement by user of the industry the application of Confocal Microscopy is preferable compared to the White Light Interferometry.

4 Conclusion

The fundamental investigations for the development of 2D-inspection solution for cutting inserts were carried out in close co-operation with partners of tool and measurement equipment industry /1/.

The first development works in conjunction with the White Light Interferometry and the Confocal Microscopy were supported by companies of the grinding tool industry /5/.

References:

- [1] Lahmann, H.-W.: Integration of a Vision System for the Profiling of Cutting Tools in a Grinding Process. EUTIST-IMV Meeting, Pori (Finland), 27./28.May 2002
- [2] Ernst, D.; Grüner, E.; Lahmann, H.-W.; Moser, W.: Bildverarbeitungssystem bewertet Schneidplattenverschleiß. Qualität und Zuverlässigkeit, 5/2004. S. 114-116
- [3] Lahmann, H.-W., Hage, H.: Optische Messtechnik an einem KMG steuert die Fertigung von Zerspanwerkzeugen. VDI-Berichte Nr. 1914, 2005, S.177-186
- [4] Lahmann, H.-W., Stöckmann, M.: Messtechnische Bewertung von Schleifwerkzeugoberflächen auf Basis der konfokalen Mikroskopie. 6. Oldenburger 3D-Tage, Oldenburg, 1./2. Februar 2006
- [5] Barthelmä, F.; Lahmann, H.-W.; Stöckmann, M.: Qualitätsbewertung von galvanisch gebundenen Diamant-Schleifwerkzeugen mittels Bildverarbeitung. IDR 37 (2003) Nr. 4, S. 302-307

Authors:

Dipl.-Phys. Heinz-Wolfgang Lahmann
Dipl. Wirtsch.-Ing. (FH) Marius Stöckmann
Gesellschaft für Fertigungstechnik und Entwicklung e.V., Näherstiller Str. 10
98574, Schmalkalden
Phone: +49 3683 69000
Fax: +49 3693 690016
E-mail: info@gfe-net.de